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ABSTRACT

An ethnomathematics approach to the curriculum is advocated as a means of addressing the problems faced by limited English proficient (LEP) students who experience difficulties in learning mathematics. It is noted that the problems may have little to do with difficulties in processing mathematical ideas. When LEP students are from different cultures, speak languages other than English as their primary language, and have preferred differences in cognitive processing, the typical approach to organized mathematics instruction observed in current American classrooms is not appropriate. The fact that a language deficit will automatically lead to a mathematics deficit is acknowledged. Research conducted with American Indians, including reservation Crow, is cited that identified three areas in which those students have difficulty in learning mathematics: language, culture, and learning modality. For example, in the beginning grades, mastery of concepts in the Crow language could not be used to facilitate the learning of the same concepts in the English language, because the concepts were not developed in the native language. In addition, the problem was exacerbated by students seeing little or no use for mathematics learned in school and by being presented with instruction that includes few manipulatives and visuals. Further research should focus on determining how familiar situations and tactile and visual approaches, integrated with systematic language activities, can be used to help students improve their performance. Contains 11 references. (LB)

An Ethnomathematics Approach to Teaching Language Minority Students

David M. Davison

Limited English proficient (LEP) students experience difficulties in learning mathematics that may have little to do with difficulties in processing mathematical ideas. When these LEP students are from different cultures, speak languages other than English as their primary language, and have preferred differences in cognitive processing, the typical approach to organized mathematics instruction observed in American classrooms today is not appropriate. An ethnomathematics approach to the curriculum is advocated in this paper as a means of addressing this concern.

D'Ambrosio (1985) defines 'ethnomathematics' as the mathematics needed by a particular subgroup of the population, be it an occupational group or a cultural group. Ethnomathematics includes curricular relevance, but is much more than building a curriculum around the local interests and culture of the learners. This local focus can become limited to the mathematics the students want to study, which they see related to either their traditional or emerging roles. While it is important not to ignore this local perspective, such an approach can overlook the organization of mathematical ideas and preclude the development of a structured mathematics curriculum. The goal is to provide students with mathematics content and approaches that will enable them to successfully master modern mathematics. An ethnomathematics approach to the curriculum can be a vehicle for achieving such a goal.

To illustrate this thesis, I will refer to work I have done with American Indians. Davison and Schindler (1988) identified three areas in which native students have difficulty

in learning mathematics: language, culture, and learning modality. It is too easy to attribute the minority students' difficulties in learning mathematics to any one factor alone. For example, minority students perform very poorly on standardized tests from the third or fourth grade on, while in the early years their performance is closer to average (see Leap, 1988; De Avila, 1988). Standardized tests, by their very nature, place great importance on language skill. A student who is an inadequate reader and has poor mastery of English language vocabulary is at a serious disadvantage.

Thus it is clear that a language deficit will automatically lead to a mathematics deficit. LEP students from the majority culture are subject to pressure to succeed by compensating for these deficiencies. Minority students typically do not receive such pressure because influences outside the school are unable to address the problem. Furthermore, minority students are not motivated by test taking. They find the questions irrelevant to their interests and, apparently, do not respond to them seriously. This problem signals the need for questions that students would be willing to treat seriously. Finally, the minority students perform poorly on the tests because they do not understand the mathematical processes. Such understanding is usually motivated through the use of manipulatives and visuals. In short, in competing with mainstream students on standardized tests, minority students are disadvantaged through an interplay of language deficiency, cultural dissonance, and inappropriate instruction.

We shall consider first the students' difficulties with the English language. Schindler and Davison (1985) surveyed dominant Crow language speakers, who viewed Crow as the language of the home and English as the language of the school. Such a dichotomy makes it very difficult for educators to fulfill the objectives of bilingual education. The intent is that the program should use the students' mastery of the native language to assist in acquiring mastery of the English language. This supposedly happens, for example, through the use of both languages in introducing primitive concepts in mathematics. Davison and Schindler (1986) found that the students' knowledge of mathematics terminology in the Crow

language was very limited. Clearly, in the beginning grades, mastery of concepts in the Crow language could not be used to facilitate the learning of the same concepts in the English language, because the concepts were not developed in the native language. The problem was exacerbated further by the students seeing little or no use for the mathematics they learned in school. An emphasis in school classrooms on textbook-dominated teaching only made the problem worse.

The problem of fluency in the English language has already been identified. When English is not spoken in the home, or when the English that is spoken lacks the sophistication of mainstream English, classroom English is not reinforced outside the school. In mathematics this means that English language mathematics vocabulary may not be used outside the classroom, and further means that confusion occurs when certain terms such as 'factor' and 'product' have specialized meanings in the mathematics classroom different from their regular English language meanings. Garbe (1985) suggested that deliberate efforts must be made to overcome problems associated with sound alikes as well as with the problems mentioned above. Students need more experience seeing, hearing, and using the English language mathematics terms in context. I would assert, from extensive classroom observation, that in predominantly native classrooms, it is critical that students hear, speak, and write much more English language mathematics.

The application of native culture situations to the mathematics classroom represents one way of helping native students see relevance of mathematics in their culture, and to use this connection as a means of teaching more mathematics. One project that is doing this is "Increasing the Participation of Native Americans in Higher Mathematics" in Oklahoma (Aichele & Downing, 1985). However, I find that most native students know very little about their traditional culture. Thus an initial premise that cultural background can be used to facilitate the teaching of mathematics is unfounded. But I have found that the interaction of native culture and mathematics ideas can be mutually reinforcing. For example, Rosalie Bearcrane, while bilingual teacher at Crow Agency

School, was teaching a sixth grade class about the Crow Indian reservation. She divided the map of the reservation into six equal rectangles and assigned each portion to a group within the class. Each group had to enlarge its portion of the map by a scale of 3:1 and then had to make a plaster relief model of the enlargement. The finished products were combined to form a table-sized relief map of the reservation. This task was motivating for the students, and taught them more about their native heritage while they learned more mathematics. In other situations, such culturally relevant phenomena as hand games, arrow throws, and bead loomwork have been used as a basis for stimulating classroom mathematics.

While these situations do engage student interest and represent a way of improving the teaching of mathematics to native students, it does represent only a limited aspect of the meaning of ethnomathematics. Ethnomathematics must be understood in terms, not only of the traditional native culture, but also of its emerging identity, one that lives side by side with the mainstream culture. In this sense, an ethnomathematics approach to the curriculum will draw on traditional culture while focusing attention on the mathematics needed by these students in an integrated society. A curriculum perceived as irrelevant by native students cannot fulfill that objective. Whether the illustrations are traditional or modern, they must engage the students' attention if the students are to be helped in understanding the important mathematical ideas.

The other factor affecting the native students' learning of mathematics is their preferred style of cognitive processing. There is strong informal evidence to suggest that minority learners, in particular, have a strong preference for a more tactile, visual approach to mathematics instruction. From extensive classroom observation, I can assert that manipulatives and visuals are not used significantly in elementary mathematics instruction, especially after the primary grades. While I maintain that this hampers the mathematics learning of all students, the effect on minority students appears little short of devastating. The apparent success in minority classrooms of programs such as

Mathematics Their Way (Baratta-Lorton, 1976) and "Math and the Mind's Eye" (Maier, 1985) attests to the importance of using varied instructional stimuli. It is clear that most minority students are not making the transition to mainstream symbolic mathematics. They need more experience at the concrete and semi-concrete levels and more assistance in bridging the gap to abstract mathematics.

In more recent work, the author provided seventh and eighth grade students with experiences to help overcome these deficiencies. These students were introduced to a manipulative approach to fractions and logic activities. The students also had to describe these tactile experiences in writing. In addition, assigned activities included creating related story problems and having them solved by their peers. Most of the students responded positively to this approach. One noteworthy exception was the student with the highest mathematics achievement; he disliked using manipulatives and would not take the writing activities seriously because they required careful thought. He was deficient in language skills, and his mathematics test scores were alleged to be a reflection of memory skill. Serious questions are raised whether this student and many others with satisfactory mathematics test scores possess the capabilities credited to them. Therefore, there may be many minority language students who mask deficiencies in mathematical understanding by performing adequately on mathematics tests.

In another classroom, seventh and eighth grade remedial mathematics students were assigned writing tasks in mathematics: journal writing, descriptions and explanations of procedures used, and creation of problems. Analysis of the observational data has indicated that the students benefit from this attention to language in the mathematics class (Davison & Pearce, in preparation).

The focus of attention in the continuation of these studies is to determine how familiar situations and tactile and visual approaches, integrated with systematic language activities, can be used to help students with below average language skills to improve their level of language functioning as well as their performance in a wider range of mathematics

objectives. An ethnomathematics solution to the problem calls for the use of the familiar to help these language minority students to accept the need to learn the mathematics needed for survival in our society and to be motivated to work to accomplish that goal.

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